ECE 109 – MIDTERM

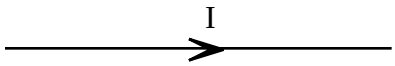
FALL 1998 **A.P. FELZER**

You may consult **your** notes and any books you may have or borrow from the library as well as any computer software or plotting calculators to do the following problems. But you **may not** under any circumstances for any reason talk to any person about the exam except for Felzer. If you **do discuss** this exam or **in any way** make use of the work of others, you will **fail** the course and have a letter put in your file explaining why.

Neatness counts. Completeness counts. Conciseness counts. In addition it should be obvious what each problem is, how you're solving it and what your answer is. You should draw all circuits (including equivalent circuits), draw appropriate graphs, set up appropriate tables and label equations. Note that it is better to do a problem with brute force than not at all. But it's better to do a problem "simply". Include any pertinent computer printouts. Be sure you start early enough so that you have time to think about and double check your work

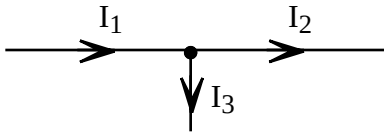
1. Write out a page of notes you would use for this midterm if it was closed book

2. How does reversing the reference direction of I in the following wire

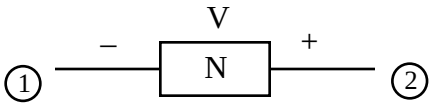


   a. Affect the sign of the current
   b. Affect the direction equivalent positive charge is flowing in the wire

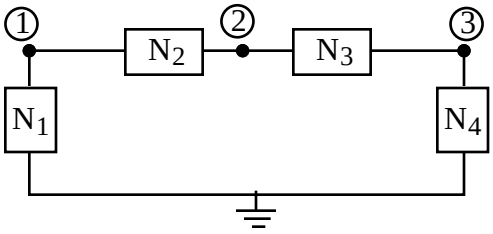
3. Which way is equivalent positive charge flowing through each of the following wires



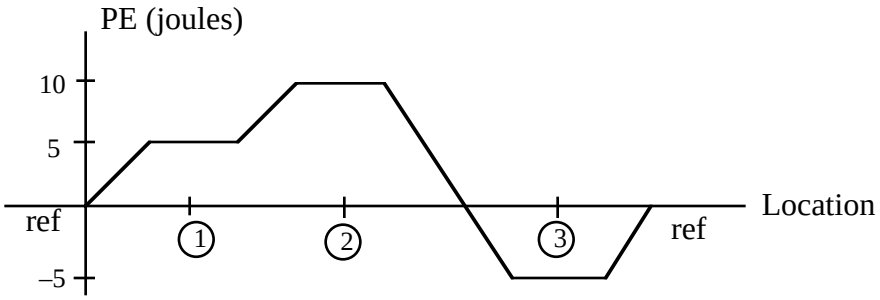
4. Which node of the following circuit element is at the higher potential



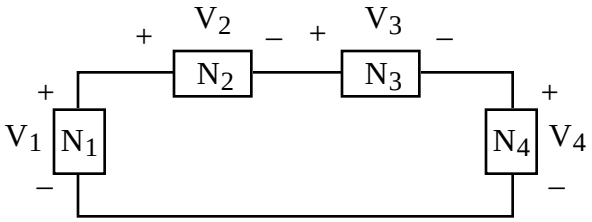
5. Suppose the potential energy of 2 coulombs of equivalent positive charge flowing clockwise around the following circuit



   varies as follows

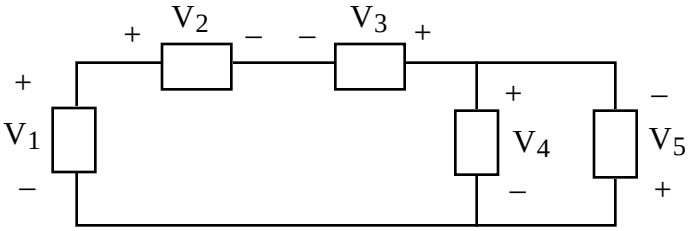


a. Find the potentials at each of the nodes
b. Find each of the following voltage drops



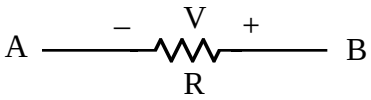
c. Draw a circuit of voltage sources and resistors having the same voltage drops across its elements as the circuit in part (b)

6. Given the following circuit

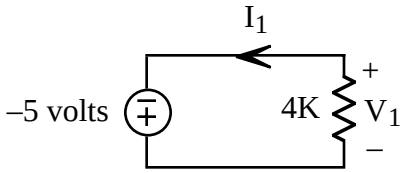


with $V_1 = 5$ volts, $V_2 = 2$ volts and $V_3 = 1$ volt. Find V_4 and V_5

7. In which direction is equivalent positive charge flowing through the following resistor

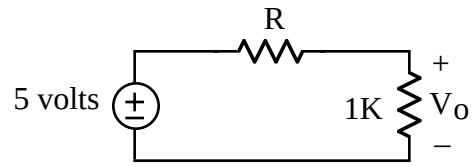


8. Find I_1 and V_1 in the following circuit

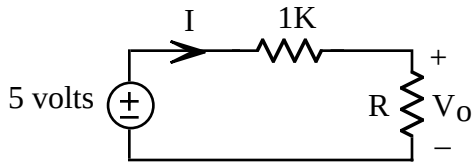


Justify each step

9. Find R in the following circuit if $V_o = 2$ volts

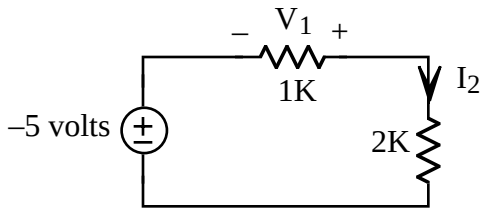


10. Given the following circuit



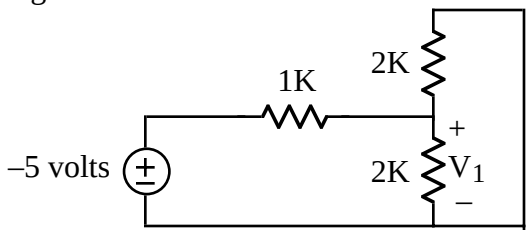
a. Sketch I and V_o as a functions of R
b. What's the upper limit on how large V_o can be in this circuit

11. Given the following circuit

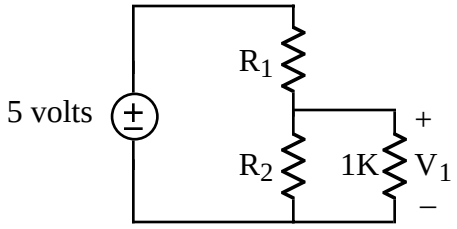


a. Find V_1 and I_2
b. How long will it take the battery to deliver 10^5 joules of energy to the circuit

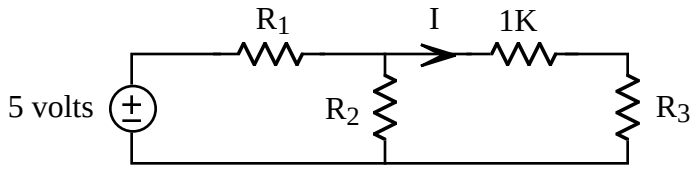
12. Find V_1 in the following circuit



13. Find realistic values of R_1 and R_2 in the following circuit so that $V_1 = 2.5$ volts

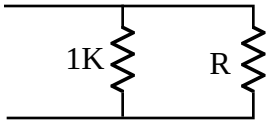


14. What's the most I can be in the following circuit



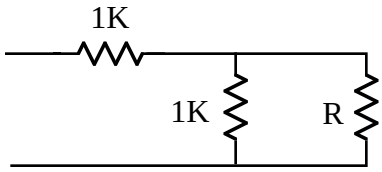
What are the corresponding values of R_1, R_2 and R_3

15. Sketch a graph of the equivalent resistance of the following circuit



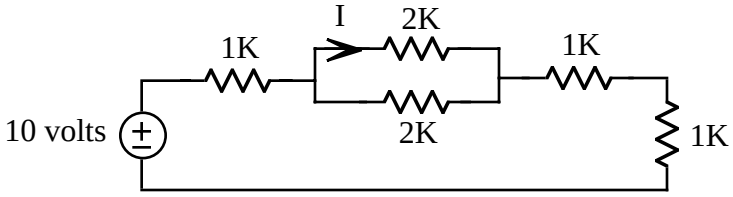
as a function of the resistance R. Explain why your graph looks the way it does

16. Sketch a graph of the equivalent resistance of the following circuit

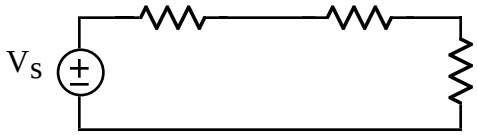


as a function of the resistance R. Explain why your graph looks the way it does

17. Find I in the following circuit

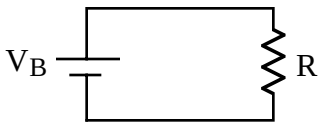


18. What will happen to the power being delivered to the resistors in the following circuit



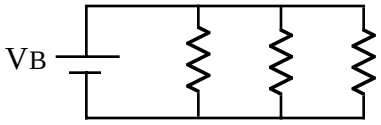
if the equivalent resistance increases by a factor of 3.

19. How will increasing R affect the lifetime of the battery in the following circuit



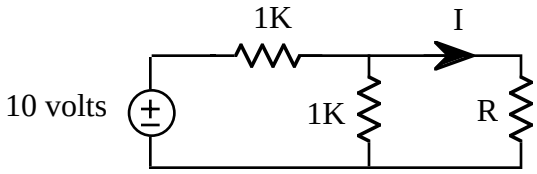
Justify your answer

20. How will adding another parallel resistor to the following circuit

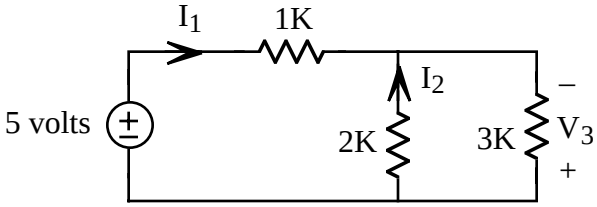


affect the lifetime of the battery. Justify your answer

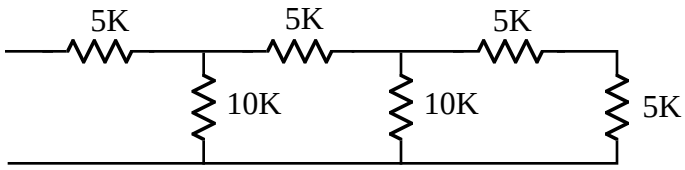
21. What is R in the following circuit if I = 1 ma



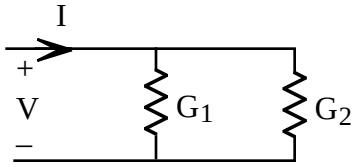
22. Find I_1, I_2 and V_3 in the following circuit



23. Find the equivalent resistance of the following circuit

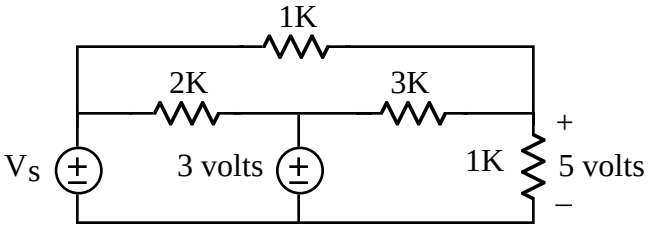


24. Show that the equivalent conductance G = I/V of the following parallel circuit

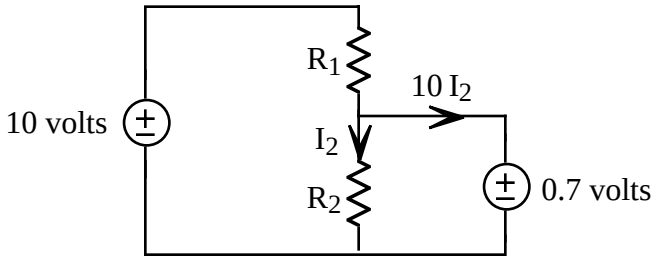


is the sum of the conductances $G = G_1 + G_2$

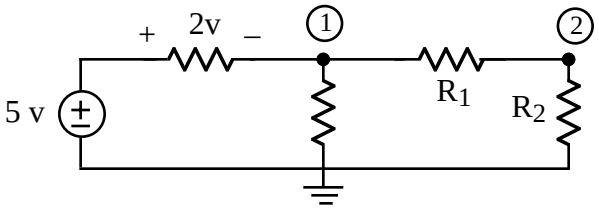
25. Find V_S in the following circuit



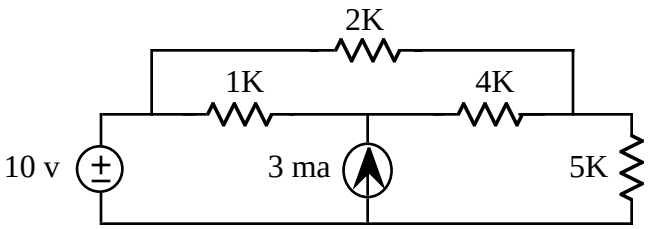
26. Find practical values for R_1 and R_2 in the following circuit so that the currents through R_2 and the 0.7 volt source are related as indicated



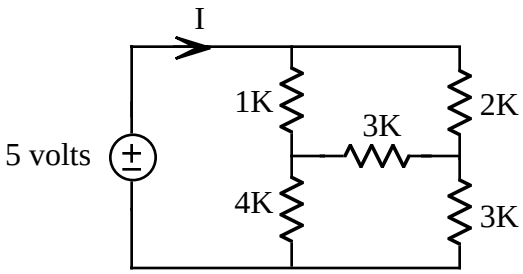
27. Find the node voltages of the following circuit if $R_1 = 2R_2$



28. Write and put in matrix form the node equations of the following circuit



29. Find I in the following circuit (without using SPICE)



30. Write out the SPICE data file for analyzing the following circuit